JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. 21 DECEMBER 4, 1931 No. 20

BOTANY.—*Notes on yagé, a drug plant of southeastern Colombia.*[1] C. V. MORTON, U. S. National Museum. (Communicated by E. P. KILLIP.)

The National Museum has recently received from Mr. Guillermo Klug, of Iquitos, Peru, a large collection of plants obtained by him in the Putumayo region of southeastern Colombia. Mr. Klug became especially interested in various drug plants used by the natives as stimulants, and included herbarium specimens of these in his collection. Three of the plants, known to the Indians under the general name of *yagé*, belong to the genus *Banisteriopsis* C. B. Robinson (Family Malpighiaceae), subgenus *Eubanisteriopsis* Morton, nomen novum (*Banisteria* subgenus *Eubanisteria* Niedenzu). The necessity for using the name *Banisteriopsis* for this genus has been discussed by the author in a former paper.[2] The type of the genus (and subgenus) is *Banisteriopsis argentea* (Kunth) Robinson & Small.

Banisteriopsis inebrians Morton, sp. nov.

Sect. *Camptostylis*, Subsect. *Cosmiothamnus*. Liana altissima plus quam 30 m. scandens, ramulis jam hornotinis demum usque 4 mm. diametro fuscesentibus glabratis teretibus striatis lenticellis numerosis instructis, internodiis 5–6 cm. longis; lamina foliorum oppositorum late elliptica basi rotundata obliqua apice solum acuta, ca. 11 cm. longa, 6.5 cm. lata, supra laevis nitida olivaceo-viridis, subtus concolor mox utrinque glabrata (pilis perpaucis persistentibus exceptis), margine paullo revoluta subcoriacea, nervis mediis primariisque supra depressis subtus elevatis prominentibusque, utrinque jam demum dense strigosis, nervis primariis utrinque 4 vel 5 valde decurrentibus, basi nervorum infimorum glandulas 2 magnas nigras gerentibus, nervis

[1] Published by permission of the Secretary of the Smithsonian Institution. Received October 28, 1931.

[2] "A new *Banisteria* from Brazil and British Guiana," Proc. Biol. Soc. Wash. 43: 157. 1930.

secundariis inter se parallelis vix prominulis; petiolus 10–12 mm. longus, ca. 1.5 mm. crassus, supra valde canaliculatus strigosus eglanduliferus; stipulae ad glandulas pubescentes magnas demum deciduas reductae; flores non suppetunt; inflorescentia axillaris, fructu vix ultra 5 cm. longa, paullulum composita, rhachi 4–9 umbellas gerente, umbellis ipsiis 4-floris, pedunculo inflorescentiae 6–14 mm. longo, pedunculis umbellarum 12–14 mm. longis, pedicellis sessilibus 13–14 mm. longis, sicut pedunculis persistente pubescentibus; sepala ovata obtusa puberula ca. 4 mm. longa, incurva, glandulas 8 oblongas ca. 2 mm. longas gerentia; styli recti apice orbiculari-capitati, anticus 3.5 mm. longus rectus 2 posticis crassior longior; samarae nuce densissime sericeae, ceterum demum parce strigosae; nux nigro-fusca oblonga, uno latere solum reticulato-rugosa, altero in alulas vel aculeos biseriatos ad 2 mm. longos excrescens, areola ventrali orbiculari 5–5.5 mm. diametro concava; ala dorsalis fere verticalis, late semiobdeltoidea, ca. 3.5 cm. longa, basi ca. 7 mm. lata, infra apicam ca. 16 mm. lata, margine antico incrassato recto basi vix appendiculato, margine postico curvato crenulato.

Banisteriopsis caapi[3] diversa esse patet: petiolis subgracilibus apice 2 glandulis magnis instructis, stipulis minutis subulatis, laminis foliorum longe acuminatis, majoribus (usque 17 cm. longis, 6–9 cm. latis), nervis mediis et primariis demum glabris, inflorescentia valde majore, pedunculis umbellarum subnullis, stylo antico 2 posticis breviore, et ala samarae oblique oblongo-obovata. *B. quitensis*[4] a nostra differs videtur: foliis longe acuminatis, fere eglanduliferis, stipulis parvis, inflorescentia terminali (?), magna 3 dm. longa, stylo antico 2 posticis breviore, lateribus nucis leviter solum tuberculatis fere laevibus, et alis minoribus (2.5 cm. longis, 11 mm. latis), obliquo-oblongis.

Type in the U. S. National Herbarium, no. 1,517,293, collected at Umbría, 0° 54′ N, 76° 10′ W, Comisaría del Putumayo, Colombia, in forest, alt. 325 meters, Jan.-Febr., 1931, by G. Klug (no. 1964).

Mr. Klug's note reads, "1964. *'Yagé del monte.'* From root to tip, more than 30 meters long. It takes 6 men to drag the lower half when cut. I estimate that this half weighs more than 500 kg." Over 60 herbarium sheets of this plant were prepared by Mr. Klug, all of which have been examined in preparing the above description.

The related species *Banisteriopsis caapi* and *B. quitensis* are also powerful drug plants. The former is more closely related, differing in having the petioles bi-glandular at apex, the stipules minute and subulate, long acuminate leaves with glabrous midvein and nerves, the inflorescence much larger, the peduncles of the umbels very short, the anterior style shorter than the two posterior, and the samara wing obliquely oblong-obovate. *B. quitensis* has quite differently shaped samaras from those of our species. It is however perhaps much more nearly related to *B. caapi* than its disposition by Niedenzu would

[3] *Banisteriopsis caapi* (Spruce) Morton, nomen novum. (*Banisteria caapi* Spruce; Grisebach in Flora Brasiliensis 12[1]: 43. 1858.)

[4] *Banisteriopsis quitensis* (Ndzu.) Morton, nomen novum. (*Banisteria quitensis* Ndzu. in Ind. lect. Lyc. Brunsverg p. hiem. 1900–1901: 10. 1900.)

indicate. The character which he stresses, namely the long-decurrent primary veins, is a variable one, being found in all three of the species here discussed. The length of the decurrent portion is apparently far from constant and is probably of no diagnostic value.

The following notes on the use and effect of the drug *yagé* are kindly supplied by Mr. Klug. The *yagé cultivado* referred to (*Klug* 1934) is apparently *Banisteriopsis quitensis*, but the specimen is sterile and the determination therefore doubtful. The specimens of *oco yagé* or *chagro panga* (*Klug* 1971) also are sterile. The leaves however appear to be very like those of *Banisteriopsis rusbyana*,[5] of which two sheets of the type collection[6] are in the U. S. National Herbarium.

"One of the most interesting plants found in the region of the upper courses of the Putumayo and Caquetá Rivers is the *yagé*. The Indians make a beverage from either the wild or cultivated *yagé*, boiling it in a large earthenware vessel an entire day until there is formed a sort of liquid, like the syrup of sugar cane. They add to the *yagé* the leaves and the young shoots of the branches of the *oco yagé* or *chagro panga* (no. 1971), and it is the addition of this plant which produces the "bluish aureole" of their visions. These are like cinematograph views, and occur after about a half liter of the drink has been consumed in portions an eighth of a liter each at intervals of half an hour. Thereafter, the Indian falls into a profound sleep during which he is in a state of complete insensibility and anesthesia. During this period the subconscious activity acquires enormous intensity. The dreams follow each other with extraordinary precision and clearness. giving to the intoxicated person, according to the observations of missionaries, the power of double vision, and of seeing things at a distance, like certain mediums in their trances. Upon awakening, he retains clearly the hallucinations and fantastic visions which he experienced in unknown regions. Perhaps this drug has the property of developing the psychic faculties. In 1919 Dr. Zerda Bayon, specialist in the chemistry of plants, gave this plant the name *Telepatina*.

"Prof. Barriga Villalba experimented upon animals with the yageina, which he succeeded in isolating, with the following results: If a horse has a weak dose of a few centigrams per kilogram of its weight injected into it an extreme excitation is produced, and the animal runs in all directions. The body begins to tremble and the animal maintains its equilibrium with the greatest difficulty. With a larger dose, something like twenty centigrams per kilogram, the yageina becomes a real poison, and the animal loses its equilibrium, cries, falls into convulsions, its temperature is lowered, and anesthesia becomes

[5] *Banisteriopsis Rusbyana* (Ndzu.) Morton, nomen novum (*Banisteria rusbyana* Ndzu. in Ind. Lect. Lyc. Brunsberg. p. aest. 1901: 19. 1901).

[6] Beni River, Bolivia. July, 1886, *Rusby* 2171; distributed as *Hiraea*.

general. The same results were obtained with dogs, in which complete anesthesia without loss of vision or sense of smell was proved.

"The small doses which Barriga Villalba tried upon himself produced a profound sleep and certain sensations of well-being. But this was very far from being the effect on the savages, for which reason Professor Muñoz, of Colombia, employed 30 to 40 grams of the drink, prepared according to the manner of the natives. Effect: At first there was a slight stimulation of the nerves, similar to that of caffein, then a slight dilation of the pupils. All exterior objects acquired a strange appearance, aureoled and of a blue color. Then came the most extraordinary hallucinations, resembling those of hashish, very magnificent, very terrifying. These are due without doubt to the excitation of the cerebral centers of vision, the sensibility of which is such, that the person who has taken *yagé* is capable of *seeing objects in the midst of the most complete obscurity.*

"In Umbría I have had occasion to converse with persons of education who have told me of taking yagé, prepared by the savages (but without the addition of the leaf of *chagro panga* or *oco-yagé*) for the cure of malaria from which they suffered, and they have assured me that with three drinks of this (about 150 grams) they have been cured completely, and that for several years they have not suffered further from this illness."

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

GEOLOGICAL SOCIETY

478TH MEETING

The 478th meeting of the Society was held in the Assembly Hall of the Cosmos Club, April 22, 1931, President O. E. MEINZER presiding.

Informal communications: H. D. MISER described certain small anticlines exposed in the Cason shale at the Cason manganese mine near Batesville, Arkansas, and ascribed them to compaction of the shale above an irregular buried topography. The Cason shale rests unconformably on the Fernvale limestone, the relief of the surface of unconformity being about one foot. Above each buried hill the shale is folded into an anticline and above each valley it is folded into a syncline. The folds are not aligned and they die out about 3 feet above the top of the limestone. The shale contains fossil algae that are normally spherical but that are so flattened in the Cason shale that their present minor diameters are about one-third their original lengths. The major diameters are parallel to the bedding of the shale. It is believed, therefore, that the shale has been compacted to about one third its original thickness. Miser pointed out that some believe such folds yield part of the petroleum in the mid-Continent oil fields.

Regular program: C. N. FENNER and A. L. DAY: *Borehole investigations in the geyser basin of Yellowstone National Park.*—For a number of years the Geophysical Laboratory of the Carnegie Institution of Washington has been

making a comprehensive study of the geysers and hot springs of Yellowstone Park. In connection with this study exploratory boreholes have been put down to a depth of several hundred feet at two sites in order to determine the underground conditions on which the surface manifestations of geyser activity are dependent. The first hole was drilled in 1929 in Old Faithful Basin, and the second in 1930 in Norris Basin. At both sites the holes were in hot areas not far from active vents.

At Old Faithful the drill penetrated beds of indurated sand and gravel to a depth of 220 feet. These sediments apparently had been accumulated in basins overdeepened by glacial scour. The component material is rhyolite, now much altered by the circulating hot water and consolidated by the deposition of secondary minerals. From 220 feet to the bottom of the hole at 405 feet, rock in place was penetrated. This bedrock was likewise rhyolite, either glassy or lithoidal. The temperature in the hole increased progressively though somewhat irregularly to a maximum of 180°C. at the bottom. Steam which contained small amounts of hydrogen sulphide and carbon dioxide was encountered, the maximum pressure being 57 pounds to the square inch.

In both the sediments and in the underlying rock there were numerous small seams and fissures in which opaline silica, quartz, chalcedony, adularia, calcite, and the zeolites analcite and clinoptilolite had been deposited together with other secondary minerals. Even the unfractured rock was likewise impregnated with these minerals.

In the second hole, drilled in the Norris Basin, sedimentary beds such as were found at Old Faithful were lacking, and rhyolite in place was encountered just below the surface. This rock has been considerably altered, with the formation of quartz, adularia, and tridymite. Hydrogen sulphide was evidently more abundant than at Old Faithful and consequently pyrite is a fairly abundant secondary mineral. In the Norris hole the maximum temperature was 205°C.

In the borehole in the Norris basin steam pressure as great as 300 pounds to the square inch was encountered. This is the highest pressure on record for such drilling projects, and it increased the difficulties enormously. The bedrock was found to be much fissured, and there was apprehension that it might be uplifted bodily and a great crater formed. Drilling operations were slowed down greatly, and finally when the hole was 265 feet deep, a break developed in the casing, probably produced by the abrasion of the grit carried by the uprushing steam. No means of repairing the casing was found, and it brought operations to a close at a less depth than had been contemplated. Difficulties such as those encountered in drilling this hole must be contended with in any attempt to tap underground sources of power under similar conditions, or to put down holes for investigative purposes.

It is believed that the data on rock texture and underground temperatures that were obtained in these holes will permit amplification of Bunsen's theory of geyser action in a number of respects, and will explain various manifestations visible at the surface. Detailed petrographic and chemical studies of the drill cores are still in progress. (*Author's abstract.*)

Discussed by Messrs. JOHNSTON and SHENON.

W. H. BUCHER: *The mobile belts of the earth.*—The structural features of the face of the earth result from the deformation of the crust. Two mutually incompatible views as to the physical character of this crust are being held

by geologists at present. One assumes that the acid and basic materials of the crust differ so much in strength that the acid materials can maintain their form in pushing laterally through the basic materials and also in extending downward into levels of higher temperature. The other view assumes that the strength of both materials is of the same order of magnitude. In the second case the base of the crust, that is, the zone in which the strength reaches zero, is a fairly smooth surface from 30 to 100 miles below the earth's surface.

A number of observations have convinced the writer that the first view is untenable. Two of these are: (1) If there were an essential difference between the strength of basic and acid materials, it should result in corresponding differences in surface forms produced by structural deformation. This does not seem to be true. Essential features of what are commonly called "grabens" for instance, are seen to be identical on continents and on sea bottoms. (e. g. Bartlett Trough; Tanganyika Trough, etc.) (2) Shepherd and Greig have demonstrated experimentally that the temperature at which rocks of granitic composition would flow is much lower than for basalt.

Adopting the second view, we think of the crust as a definite shell which is capable of transmitting stresses. The presence of long linear structural features points to stresses which acted on the crust at large. The most striking features of this type are the long belts of mountain *folding* (e. g. Antillean system and the Alpine Mountains of Europe, N. Africa, and Asia) and of graben *faulting* (e. g. African fault belts of which rift valleys are a conspicuous part). This paper deals with the relation between these two extreme types of linear crustal deformations.

The chief structural features of the fault belts are believed to owe their existence to tensional stresses. Besides these, however, there are indubitable evidences of compressive stresses. This is reflected in a curious way by the fact that the same series of hypotheses of origin have been suggested for three conspicuous examples: the Rhine graben, the African rift valleys, and the Great Basin. ("Key-stone" theories of Elie de Beaumont, Gregory, and Le Conte, 1878; tensional theories of Suess and Le Conte, 1888; compressive wedge theories of Andreae, Wayland, and Link).

The writer believes that these three typical regions originated under tensional stresses and were modified by subsequent compressive stresses. The distinctive feature of these belts is that under compressive stresses they developed a minimum of mobility. The writer, correspondingly, designates them as "fracture belts of low mobility."

Such regions as the areas of Saxonian folding in northern Germany and the Coast Ranges of California of post-Franciscan time display a curious combination of fault-block pattern and rock folding. The writer contends that the fault dislocations took place under tensional stresses in epochs of general crustal expansion and that they were modified by compression in epochs of crustal contraction. This is the same sequence as that inferred for the fracture belts of low mobility. In this second case, there is much greater mobility, but it is localized due to the mosaic arrangement of the fault blocks. The writer designates this type "heterogeneous mobile belts."

The true "mobile belts," such as the Appalachian and Alpine systems, are characterized by intensive folding, essentially without normal faulting. Their history involves a major problem which is apt to be overlooked. The folding always follows a period of "geosynclinal" sinking, but at least during

long intervals of these "geosynclinal" epochs, sinking took place without upward movements of one or both margins. This is shown by the very thick series of pure limestone which are so characteristic of such "geosynclinal" belts. ("Hochgesbirgskalk" of the Alps; Cambro-Ordovician limestones of the Appalachians). The writer knows of no adequate explanation of the origin of such long, relatively narrow troughs that sink continuously for long intervals of time without any mountain-making movements. The analogy of the "fracture belts of low mobility" and of the "heterogeneous mobile belts" suggests that these "homogeneous mobile belts" likewise owe their origin to tensional crustal stresses which create the geosynclines while later compressive stresses throw them into folds. It seems reasonable to assume that just as folding takes place with all signs of a much greater mobility than is displayed in the other two types, so the yielding under tension owes its peculiar "homogeneous" character to greater "mobility." The writer, then, suggests that these three types of major linear elements of structure form a gradational series that are produced by the same alternation of crustal tension and compression, and that differ merely in the manner of their reaction to these stresses.

One characteristic common to all three types is frequently overlooked; namely, that later belts may intersect earlier ones at any conceivable angle. This independence of later from earlier mobile belts is very difficult to understand unless just such an alternation of tension and compression in the crust is assumed, as seems to be indicated by the structural history of the belts themselves. (*Author's abstract.*)

Discussed by Messrs. MOORE, FERGUSON, RUBEY, and G. R. MANSFIELD.

CARLE H. DANE and A. M. PIPER, *Secretaries.*

SCIENTIFIC NOTES AND NEWS

The Innsbruck meetings of the International Commission on the Polar Year were held September 23, 25, and 26. Among the many resolutions passed one provided that there should be no postponement of date since so many governments were participating.

Five meetings of the International Commission of Terrestrial Magnetism and Atmospheric Electricity were held at Innsbruck September 21, 22, and 23.

Observations made on the Graf Zeppelin's arctic flight last July indicate that sea fog in the arctic is a relatively thin blanket varying from a few hundred to one thousand feet that can be easily surmounted in aerial navigation.

A general meeting of Aeroarctic is to be held in Berlin, November 7, 8, and 9.

The International Electrical Congress will meet at Paris in July 1932.

The recently formed Section of Hydrology of the American Geophysical Union announces the organization of a Committee on the Hydrology of Glaciers, composed of the following men: STEPHEN R. CAPPS, Senior Geologist, Alaska Branch, U. S. Geological Survey: Dr. HARRY FIELDING REID, Professor Emeritus of Dynamic Geology, Johns Hopkins University; G. L. PARKER, District Engineer, Water Resources Branch, U. S. Geological Survey; CARL P. RICHARDS, Chairman of the Research Committee of the Mazamas, Portland, Ore.; R. H. SARGENT, Senior Topographic Engineer, Alaska Branch, U. S. Geological Survey; Dr. WALLACE R. ATWOOD, Assistant,

Branch of Research and Education, National Park Service; FRANÇOIS E. MATTHES, Senior Geologist, Section of Glacial Geology, U. S. Geological Survey, Chairman. The functions of the committee correspond in general to those of the Glacier Commission appointed by the Section of Scientific Hydrology of the International Geodetic and Geophysical Union in Europe and will consist principally in securing systematic records of the annual variations of American glaciers.

KENNETH D. LOHMAN, A. M. 1930, California Institute of Technology, has been appointed Assistant Geologist in the Geological Survey.

J. P. MARBLE, recently instructor at Harvard University, is making determinations of the age of certain uranium minerals, by means of their lead-uranium ratios, in the chemical laboratory of the Geological Survey.

CHARLES MILTON, Ph. D. 1929, Johns Hopkins University, has been appointed a geochemist in the Geological Survey.

Prof. KANZAEMON KUKUCHI, in charge of the Department of Biology, Toyama High School, Toyama, Japan, has come to the National Museum for the purpose of examining its collections of oriental invertebrates. He is particularly interested in crustacea and mollusks, and is determining a number of specimens that he has gathered in the course of his Japanese faunal studies. He expects to be in Washington for some weeks.

Dr. TEIICHI KOBAYASHI of the Geological Institute, Imperial University, Tokyo, Japan, accompanied by his wife, has arrived at the National Museum with large collections of early Paleozoic fossils. He intends to remain here for perhaps a year and a half to study these fossils where related forms are available for comparison. These collections are mainly from South Korea which is practically a virgin territory from a geological standpoint.